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ABSTRACT

Attitudes associated with science appear to affect student participation in science as a subject. This report describes a study of elementary and secondary students that sought to determine students' attitudes toward science and to examine the correlation between attitudes and ability, gender, ethnicity, grade, and science achievement. Findings indicate no significant differences between attitudes toward science as a subject and gender, except that males rated science as a subject more exciting than females did. Ethnicity did not correlate with any of the five attitudes toward science as a subject. Grade significantly correlated with attitude toward science--younger students had more positive perceptions of science than older students. Finally, science achievement correlated with attitude toward science. (Contains 29 references.) (WRM)

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Elementary and Secondary Students' Perceptions toward Science and the Correlation with Gender, Ethnicity, Ability, Grade, and Science Achievement

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ELEMENTARY AND SECONDARY STUDENTS' PERCEPTIONS TOWARD SCIENCE AND THE CORRELATION WITH GENDER, ETHNICITY, ABILITY, GRADE, AND SCIENCE ACHIEVEMENT

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Attitudes associated with science appear to be affecting student participation in science as a subject (AAAS, 1989; Koballa, Crawley, & Shrigley, 1990) and impacting performance in science (IAEP, 1992; Weiss, 1987; Linn, 1992). An international assessment of nine-and-thirteen-year-old students in twenty countries (IAEP, 1992) revealed that positive attitudes toward science influence student performance. Positive student attitudes toward science were related to higher science performance by the majority of 13-year-old students in 15 countries (IAEP, 1992). In Korea there was a notable exception; only one-quarter of the top-performing students exhibited positive attitudes toward science (IAEP, 1992).

Students in the international assessment were asked to what extent they agreed with the following statements:

- Much of what is learned in science is useful in everyday life.
- It is important to know some science in order to get a good job.
- I am good at science.
- My parents are interested in science.

A significant majority of the twenty countries had positive attitudes about the utility of science learning for both males and females despite a gender performance gap that was prevalent in nearly all of the countries (IAEP, 1992). The performance of males and females was equivalent in only two participating countries, Taiwan and Jordan (IAEP, 1992). In the Russian-speaking schools 74 percent of the students believed science was equally important for males and females (IAEP, 1992). In Korea less than two-thirds of the students believed science was equally important for males and females (IAEP, 1992); this was one of few countries in which fewer

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than 90 percent of the students perceived science to be equally appropriate for males and females (IAEP, 1992).

An examination of the major goals for science education reveals a unanimity of opinion that the development of scientific literacy includes the development of positive attitudes toward science (Lederman, 1992; Linn, 1992). One of the goals for school science that underlies the *National Science Education Standards* (1996) is to educate students who are able to experience the richness and excitement of knowing about and understanding the natural world. This development of positive atiitudes toward science is a critical component of science instruction (Gardner, 1991; NAEP, 1987). It is judged imperative that students develop, at an early age, favorable attitudes toward science (NAEP, 1987); and that this favorable orientation be maintained (Anderman & Maehr, 1994; AAAS, 1989).

Studies on gender roles and school subjects reveal the avoidance of additional science courses by females (Maple & Stage, 1991; Archer & McDonald, 1991). Schibeci (1984) reported that females exhibit more positive attitudes toward biology and males toward physics. Current data from the American Association of University Women indicate the need to focus more attention on the development of positive attitudes toward science with females (AAUW, 1992). As females progress through secondary grades, they become less confident of their academic skills; thus, their career aspirations are narrowed (AAUW, 1992; Linn & Hyde, 1989). Data from the National Science Foundation (NSF, 1994) indicate that females comprise 46% of the labor force with only 22% of the scientists being female.

Race and ethnicity may influence science achievement and attitudes toward science. In the international study (IAEP, 1992), the highest-performing 13-year-old students were those in Korea, Taiwan, and Switzerland; students from seven countries including France, Scotland, Spain, the United States, England, and China performed at the IAEP (1992) average of 67 percent. Mickelson (1990) found in his study an attitude-achievement paradox among black adolescents. Despite low levels of achievement in science, minority students, especially African-Americans, exhibited positive attitudes toward science as a subject (Mickelson, 1990). The

African-American students responded that they look forward to science class and that science will be useful to them. This paradox has been reported by other researchers (Clewell & Anderson, 1991). The purpose of this study was to determine student attitudes toward science and to examine the correlation of attitudes with ability, gender, ethnicity, grade, and science achievement

Measures

The measure of students' achievement was the end-of-year scores on the science subtests of the standardized achievement test, Science Research Associates (SRA) Survey of Basic Skills published by Science Research Associates. The contents of the science subtests of the SRA are based on learner objectives most commonly taught in science courses in the United States. The normal curve equivalent scores (NCEs) from the science subtests are represented on a scale from 1 to 99 with the difference between two successive scores on the scale having the same meaning throughout the scale.

To measure elementary and secondary students' perceptions toward science as a subject a modified form of the Osgood Semantic Differential (1957) was used. The evaluative attitudes selected were important/unimportant (1), valuable/worthless (S2), understandable/confusing (S3), exciting/boring (S4), and easy/hard (S5). The instrument included seven additional adjective pairs that were used as distractors.

The attitude scores for an individual were determined from the five evaluative scales producing a range of one, negative attitude, to seven, positive attitude. Any score of five or greater represented a positive value for an attitude. The most positive ratings for important, valuable, understandable, exciting, and easy were assigned a value of seven.

Intercorrelational Analysis of Attitudes

An intercorrelational analysis applied to the means showed significant relationships (Table 1) with the attitudes toward science and the variables of ability, gender, and grade. Ethnicity did not correlate with any of the attitudes toward science. Gender correlated with only one attitude toward science. Every attitude examined correlated with science achievement.

Ability correlated with the four attitudes: important (S1), valuable (S2), understandable (S3), and easy (S5). The attitude which did not correlate with ability is exciting (S4). Three of the attitudes toward science correlated with the high ability group; the high ability-grouped students considered science as valuable, understandable, and easy.

Table 1
Correlates of Science Attitudes

Variable	Science Attitudes				
	S1	S2	S3	S4	S5
Ability	-.0898*	.0877**	.0915*	.0212	.1025*
Gender	.0638	.0491	.0690	.1332**	.0511
Ethnicity	-.0406	-.0250	.0558	.0261	.0241
Grade	-.1421**	-.1165**	-.1500**	-.1243**	-.1690**

* Significant beyond .05 level of confidence
** Significant beyond .01 level of confidence
S1 = Important/Unimportant
S2 = Valuable/Worthless
S3 = Understandable/Confusing
S4 = Exciting/Boring
S5 = Easy/Hard

There was a significant difference in the ratings of one attitude toward science based on gender. The analysis revealed that science was rated as more exciting (S4) by males than females. The significance was beyond the .01 level of confidence as noted in Table 1.

The intercorrelational analysis showed that there was no difference in the ratings of the attitudes toward science based on ethnicity. Nonminority students in that school system did not significantly rate science more positively nor negatively than the minority students. Minorities represented 21% of the student population.

Grade correlated significantly with every attitude toward science as noted in Table 1. The Scheffe test was utilized to identify comparisons between grades. Grade comparisons of the attitude important (S1) indicated that students in grades four, five, and six rated science as a more important subject than the students enrolled in grades nine, ten and eleven. The students in grades four, five and six rated science as more valuable (S2) and understandable (S3) than the students in grade eleven.

Discussion

There were no significant differences between the attitudes toward science as a subject and gender with one exception. Males rated science as a subject more exciting than females. Conversely, the findings of other researchers show that male students in the United States demonstrate more positive attitudes toward science than do females (Czerniak & Chiarelott, 1984; Kahle, 1983; Schibeci & Riley, 1986). Recent research by AAUW (1992) reveals that although female students receive equal, or sometimes better, grades in science courses, the females exhibit less interest in science subjects than male students.

Ethnicity did not correlate with any of the five attitudes toward science as a subject. Studies that have examined race and ethnicity report that African-Americans and Latinos enrolled in middle schools responded positively to the importance of mathematics and science (Clewell & Anderson, 1991; Mickelson, 1990; Catsambis, 1994). In science, Latinos exhibit a gender gap with respect to looking forward to science class; Latino males have a more positive attitude toward science than Latino females (Catsambis, 1994).

Grade significantly correlated with each attitude toward science; the grade comparisons measured by the Scheffe test indicated that students enrolled in grades four, five, and six perceived science more positively than secondary students. A recent study reports that no significant changes have occurred in the secondary schools at Grade 10, in terms of increasing students' positive attitudes toward science as a subject even though the constructivist and science-technology-society (STC) approaches had been emphasized in that area (Ebenezer &

Zoller, 1993). As reform for preservice education and professional development continues, future studies should reflect the impact of the reform.

With multiple correlation, science achievement correlated with attitude toward science. Much of the research concerning attitude toward science and its relationship to science achievement shows low positive correlations (Schibeci & Riley, 1986; Keeves & Morganstern, 1992). Early research by Eisenhardt (1977) found that the predominant causal sequence was that a change in achievement causes a change in interest level. Further research examining psychological effects found that a student's self-concept of his ability to perform in science positively correlated with achievement (Oliver & Simpson, 1988). Further investigations should provide more evidence that science educators will be able to use in course revisions with respect to instructional strategies.

A dimension worth studying is the question of how the affective relationship is fostered in science instruction (Lederman, 1992; Haladyna & Shaughnessy, 1982). Research studies on teacher behavior patterns that promote cognitive and affective domains of science could provide data to be used with professional development models (Smith, 1990).

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